

The dressed stone manufacturing technology of Rapa Nui: A preliminary model based on evidence from the Rano Kau, Maunga Tararaina, and Ko Ori quarries

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Purposefully shaped building stones, also known as dressed or cut stones, were used in various parts of Polynesia, but nowhere was the craft as fully developed as Rapa Nui (Easter Island), where quarried stones called paenga were commonly used in the construction of ceremonial platform (ahu) walls and in the foundations of houses called hare paenga occupied by chiefs and priests. The cultural origins of the dressed stone technology of Rapa Nui has been the subject of considerable debate because of the similarities between some of the finest examples on the island and mortarless block masonry in the Andean highlands of South America. Virtually nothing is known, however, about the manufacturing technology, including the primary sources of stone, reduction strategies and sequences, the methods and tools used in the manufacturing process, the social status of the stone cutters, and the mechanisms involved in the distribution of dressed stones. In an effort to redress this problem, data from five dressed stone quarries, recorded on the southwestern end of the island in 1968, are used in developing a preliminary model of the manufacturing process. The data from these quarries, combined with archaeological and ethnographic information on the varied utilitarian, symbolic, and ritual uses of dressed stones, suggest that paenga manufacture may have developed at some point in its history into a craft specialist “industry” involving production for exchange. The ethnographic period socio-political context of the five quarries suggests that they may have been under the control of one clan, the Marama, except for the summit area of Rano Kau, where multiple clans may have had open access to what appears to have been one of the best sources of building stone on the island.

La mampostería de piedra cortada o tallada se halla en varias partes de Polinesia, pero en ningún lugar se desarrolló tal perfección en el trabajo como en Rapa Nui (Isla de Pascua), en donde piedras de cantera llamadas paenga fueron comúnmente utilizadas en la construcción de plataformas ceremoniales (ahu) y en bases para casas llamadas hare paenga, que eran ocupadas por jefes y sacerdotes. Los orígenes culturales de la tecnología de tallado en piedra de Rapa Nui han sido objeto de considerable debate, debido a las similitudes entre algunos finos ejemplos de la isla y la masonería de bloques sin morteros en los altos de Los Andes en Sudamérica. Sin embargo nada se sabe, virtualmente, acerca de la tecnología de fabricación, el método de producción y la relación entre esto y otras formas de especialización en el tallado, tales como el tallado de estatuas. Datos obtenidos el año 1968 de cinco canteras de piedra tallada en el extremo suroeste de la isla, nos proporcionan algunas ideas preliminares sobre ellas y preguntas relacionadas a la investigación. Los datos de estas canteras, combinadas con información arqueológica y etnográfica acerca de la variedad de uso tanto utilitario como simbólico y ritual del tallado y corte de piedras, sugieren que la fabricación del paenga puede haber conducido al mismo tiempo al desarrollo de una “industria” de artesanía como producción para el intercambio. El contexto sociopolítico del período etnográfico de las cinco canteras sugiere que éstas deben haber estado bajo el control de un clan, Marama, a excepción del área superior del Rano Kau, en donde múltiples clanes pudieron haber tenido acceso a lo que parece haber sido una de las mejores fuentes de piedra de construcción en la isla.

Introduction

Dressed or cut stone masonry is found in various parts of Polynesia (Linton 1925:15-19; Métraux 1937:122-125, 1940:290-291), but nowhere was the craft as fully developed and perfected as Rapa Nui (Easter Island, Figure 1), where the chiefly demand for shaped stones

resulted in the production of large quantities for use in the building of monumental ceremonial structures (*ahu*) and the foundations of boat-shaped or elliptical houses called *hare paenga* (Figure 2), occupied by chiefs and priests, and large community houses (*hare nui*), sometimes used for feasts called *koro* (Englert 1948:216-221, 299-306; Ferdon 1979; Métraux



Figure 1. Map of Rapa Nui (Easter Island), showing location of the 1968 archaeological survey area and places mentioned in the text.

1940:194-200, 343). The origins of this distinctive masonry has been the subject of considerable debate because of similarities between the finest examples on Rapa Nui, such as the seaward wall of Ahu Vinapu 1 (Figure 3; also see Englert 1970:100-101; Mulloy 1961) and mortarless block masonry structures in the Andean highlands of South America (Bahn & Flenley 1992:56-58; Ferdon 1961:533-534; Golson 1965:56; Heyerdahl 1961:497-502; Martinsson-Wallin 1994:108-122, 127-128; McCoy 1979:144; Métraux 1937:125-126; 1940:290-291; Protzen 1993). Some preliminary geochemical sourcing data are now available for a few quarries (Harper et al. 2008; Simpson n.d.), but little or nothing is known archaeologically about the manufacturing technology, the mode of production, and the relationship between this and other forms of craft specialization, such as statue carving. Data from five dressed stone quarries recorded during a site survey on the southwestern end of the island in 1968 (Figure 4; also see McCoy 1976:90) provide some preliminary insights into these and related research questions.

Because of the uneven geographical distribution and oftentimes highly localized occurrence of tool-stone and stone resources used for other special purposes, quarries hold great potential to contribute

to an understanding of cultural processes and history at the regional level. Quarries also require a regional perspective if they are to be properly understood in terms of their various relationships. In societies like that which developed on Rapa Nui, such relationships were socio-economic, political, and religious. While virtually nothing is known about dressed stone manufacture in the historical development of Rapanui society, the names for different kinds of dressed stones and their varied uses provide some indications of the socio-political and ritual significance of dressed stonework in the ethnographic present. This information, together with the virtually non-existent history of previous research on dressed stone sources and quarries, is summarized below. The main part of this paper is a description of the five quarries recorded in 1968 and the development of a preliminary model of the manufacturing technology based on a combination of the archaeological data currently available and what I believe is relevant and useful ethnographic information. The paper concludes with an examination of the ethnographic period socio-political context of the five quarries and the implications that contact period clan boundaries may have had on resource control, access, and exchange.

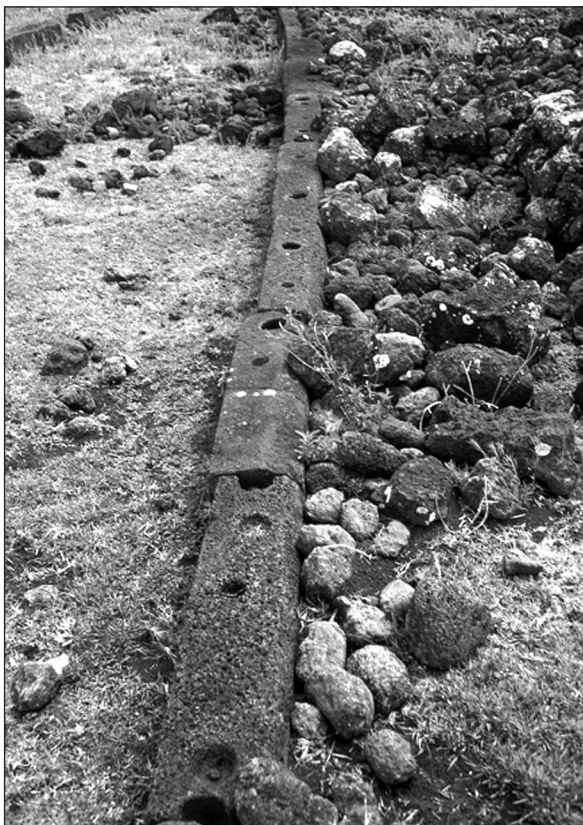


Figure 2. Dressed curbstones in a large *hare paenga* on the west coast (photo by author).

The model developed in this paper, like all models, is inherently wrong because it is incomplete. But hopefully it will stimulate some further research on a much-neglected topic in Rapa Nui archaeology.

Dressed Stones in the Rapa Nui Landscape: Named Varieties and Uses

Dressed or purposefully shaped building stones, also known as cut stones (the terms are synonymous and I use them interchangeably; cf. Linton 1925; Protzen 1993), are ubiquitous in the archaeological landscape of Rapa Nui, occurring in a variety of different contexts, in varied sizes, and in varied degrees of finish. The Rapanui recognize two classes of dressed or cut stones, each with its own name. The first and best known is *paenga*, as in the term *hare paenga*, the name for a house with a dressed curbstone foundation, which as noted above, included houses occupied by elites and communal feast houses. Métraux (1940:98) noted that the word *paenga*, by itself, was also used to refer to a “large family” and that there was an obvious link between the two meanings of the word. A second, less well-known term for dressed stones is *pae*. According to Englert (1948:480) and Fuentes (1960:810), the word *pae* refers to smaller, unfinished stones used in the construction of stone-lined earth ovens (*umu pae*) and the foundations of houses occupied by commoners.

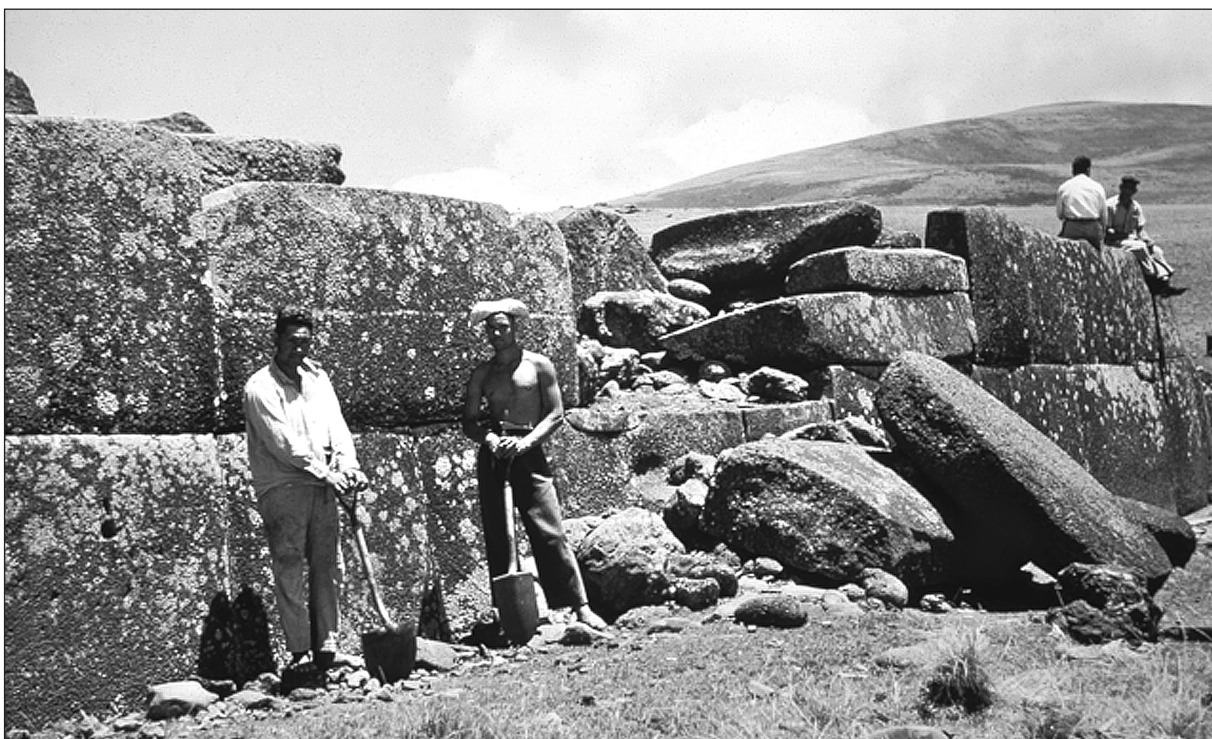


Figure 3. Ahu Vinapu 1 (original name probably Ahu Tahira) during excavation in 1955-56. Photograph courtesy of Mulloy Photo Archives.

In his early comparative study of dressed stonework in Polynesia, Linton noted that there seemed to be more variety in the shapes and methods of building with cut stones in Easter Island than elsewhere in Polynesia (Linton 1925:17). Dressed stones of both the *paenga* and *pae* variety were used for a number of purposes, such as house foundations, *ahu* platforms, and earth ovens (Englert 1948; Métraux 1937, 1940; Mulloy 1961; Smith 1961a). Dressed curbstones from *hare paenga* are found in a number of secondary contexts, including refuge caves (*ana kionga*), wells, earth ovens, and *ahu* platforms, where the curbstones were used in the re-building of the seaward walls of some major *ahu* (e.g., *Ahu Tepeu*) and even as replacements for fallen statues (*moai*). The latter, placed on the tops of *ahu* platforms where statues had formerly stood, were given a special name, *paenga moai* or “foundation-stone statues” (Heyerdahl 1961:505; Lavachery 1951:420-421).

There is some ethnographic evidence suggesting that *hare paenga* were built by specialists and that the construction involved a division of labor. Englert (1948:216-217) was told that when a man wanted to build a *hare paenga*, he called a specialist called *maori hare* to direct the work, and that this specialist then sought out groups of men to undertake the most laborious and time consuming part of the whole process, the quarrying of the foundation stones. These men, like the statue carvers, were apparently given food in exchange for their labor. According to Englert’s (1948:218) information, there was a further division of labor in the use of another group of men to make the holes into which the rafters were set, a feature apparently found nowhere else in Polynesia (Métraux 1940:202).

Many of the dressed stones found in *hare paenga* foundations are of very regular shape, with finely dressed surfaces and edges (cf. Figure 2). Métraux provides a good general description of these aesthetically embellished foundation stones:

“The size of the stone curbs varies considerably; some are only 0.5 meters long, others are 2.5 meters or more; the average breadth is between 20 and 30 cm. As most of these curbs are firmly embedded in the ground, it is difficult to estimate their total height; generally they rise 1 foot above the ground. Their depth underground must be between 30 cm and 1 meter. The unseen part is generally roughly carved and thicker than the upper part, which has sharp angles and smooth surfaces. The upper face of each slab has 2 or 3 (rarely 4 or 5) cup-shaped depressions. These cavities, in which rafters were inserted, are 5 to 8 cm. deep with a diameter of 2.5 to 5 cm. The distance between them is variable.” (Métraux 1940:194-195).

The size and elaboration of houses was clearly a function of social rank and accumulated wealth. The most visible and lasting expression of this are the dressed curbstones (McCoy 1976:48). The size and number of curbstones in a foundation obviously varied. Métraux presented a figure of 15 to 18 curbstones for an average size house, 10-15m in length and 1.5 to 2m wide (Métraux 1940:195, 200). In contrast, the 310-foot long house seen by the La Pérouse Expedition in 1786, almost certainly a communal feast house, had nearly 70 curbstones (La Pérouse 1798; Métraux 1940:Figure 16).

The socio-political and ritual significance of *hare paenga* curbstones is evident in their embellished form, their primary use in the houses of elites, and even in their secondary uses in monumental ceremonial platforms, as described above. Yet another indication of social and political value is the fact that they were taken as booty in warfare:

“The end stones of the houses are carefully worked on the curve, and it is very rare to find them still in place, as they are comparatively light, weighing from one to two hundred weight, and easily carried off. Even the heavier stones were at times seized upon as booty in enemy raids; one measuring 15 feet was pointed out to us near an *ahu* on the south coast, which had been brought all the way from the north side of the island.” (Routledge 1919:215-216).

The incomplete and asymmetrical outlines of many *hare paenga*, such as those at Vinapu (Mulloy 1961), and the common occurrence of *hare paenga* curbstones in many secondary contexts (Stevenson 1997:96), suggests that the process described by Routledge may have been common in the latter history of such houses. Where *hare paenga* foundations are found more or less intact, in many cases the curbstones are not the originals, but rather ones appropriated from other houses (Van Tilburg 1994:69).

Based on the various social, political, and even cosmological values and relationships embodied in the design and construction of the *hare paenga* (Van Tilburg 1994:72), it is possible that the removal of the most permanent and valued parts of these houses, the dressed curbstones, was somewhat akin to the overthrow and purposeful destruction of the statues, in the sense that the underlying power and authority of a chief’s house, or the lineage, in the case of a communal feast house, had been taken away by an enemy.

Previous Studies of Dressed Stone Quarrying

Prior to the initiation of an island-wide archaeological survey in 1968 (McCoy 1976; Mulloy 1968), the only reported source of dressed stones on the island appears to have been an olivine basalt flow at Rano Aroi on the north end of the island (Métraux 1940:194; cf. Figure 1). Métraux's brief description of the Rano Aroi source gives the mistaken impression that this was the only *paenga* quarry on the island. Interviews I conducted in 1968 and 1969, as part of my settlement pattern study, indicated that some of the older island residents at the time knew of cut stone quarries in different parts of the island. Santiago Pakarati described *paenga* quarries in the vicinity of Te Pahu and Vai Taki Tiki, two subterranean caverns with fresh water at Roiho, on the west coast (Englert 1948:285). He also recalled seeing cut stone quarries at Omohi on the north coast and at an unnamed locality inland of Hanga Tetenga, toward the center of the island. Daniel Ika knew of a *paenga* quarry at Maunga Opipi on the northeast coast, near Hanga

Ho'onu (Figure 1). How many other *paenga* quarries may have still been known or remembered at the time is unknown, as my inquiries were of limited scope.

Cut Stone Quarries and Isolated “Semi-Finished” *Paenga* in the 1968 Survey Area

Five sites recorded in the 1968 survey were classified as cut stone (*paenga*) quarries (Figure 4; McCoy 1976: 87, 90, Figure 41; cf. also Martinsson-Wallin 1994:Figure 82). In this paper, I have given each site or group of sites a geographical place name (e.g., Rano Kau quarries), in addition to using the formal site number from the 1968 survey (McCoy 1976). There are numerous limitations in the data used here, including the lack of information on site area and boundaries, since none of the sites recorded in the 1968 survey were mapped and described in detail. There are likewise no dates for any of the quarries because excavation was not a part of the survey.¹ The lack of information on site boundaries is especially true of the Rano Kau quarries which, based on the information in my field notes, probably include

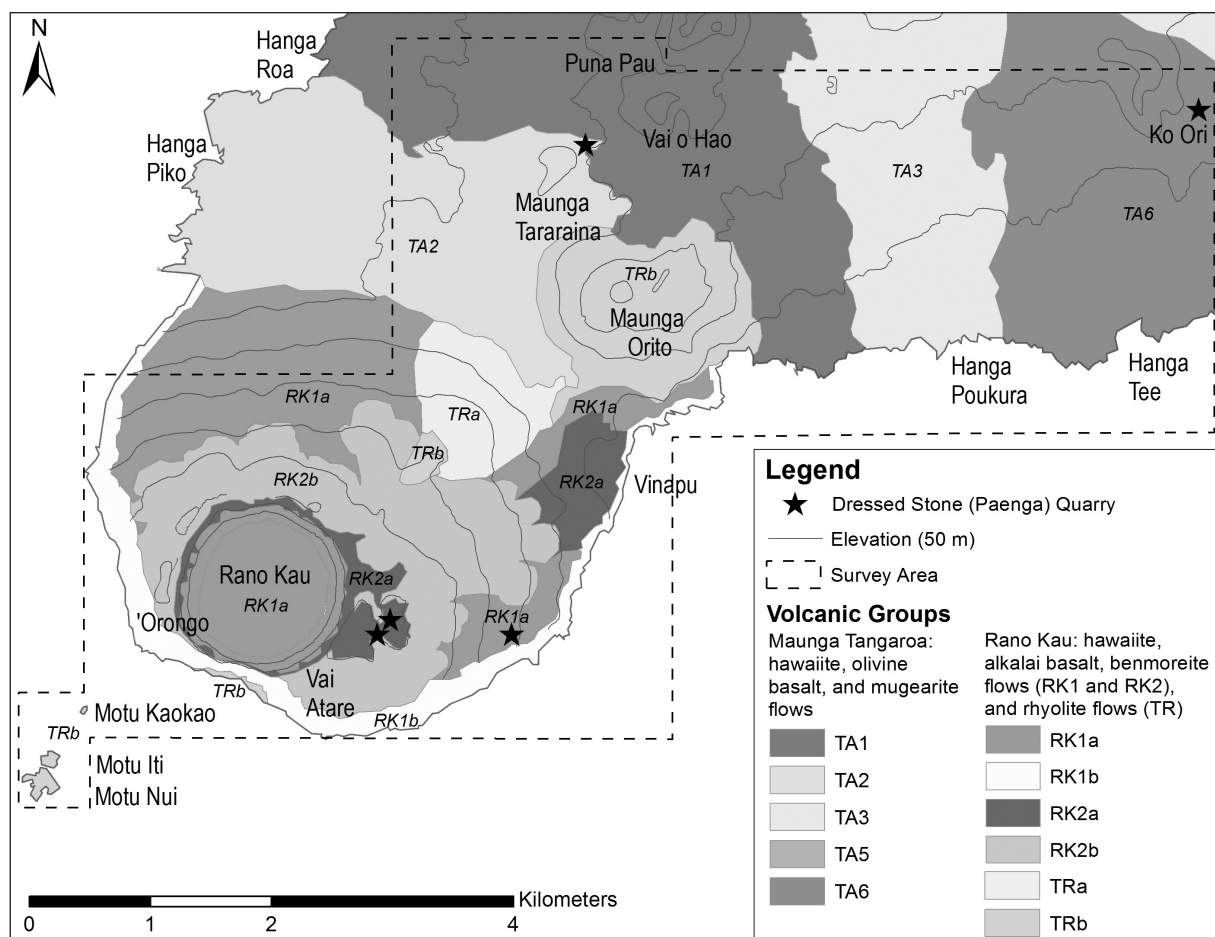


Figure 4. Locations of dressed stone (*paenga*) quarries in the 1968 survey area in relation to mapped lava flows (geology base map after Gonzalez-Ferran et al. 2004).

more sites and/or encompass a larger area than the three sites described here.

Some of the rough cut blocks found in the quarries described herein, and probably others on the island as well, would likely not be seen by archaeologists with limited field experience. In contrast to other reduction technologies, such as adze and statue manufacture, the early stages of *paenga* manufacture are barely recognizable. Full credit for identifying the first of the quarries on Rano Kau goes to my fieldworkers, who called any cut or quarried stone regardless of the size or degree of finish a *paenga*, except for those found in earth ovens, where the name *pae* was retained. A number of quarried stones of the *pae* variety were found in the 1968 survey area, mostly on Rano Kau.²

As with many archaeological sites that are called “quarries” there are no clearly defined pits or other evidence of “mining” at any of the five sites. There is evidence at some of the sites, however, of large blocks being extracted from the edges of rock outcrops that resulted in shallow depressions. Use of the term “quarry” should thus be understood to refer to raw material extraction in general and to the geologic source of the material. The sites are thus both “quarries” and “workshops,” where procurement and reduction took place together.

A pervasive methodological issue in lithic analysis and quarry studies is the problem of how to describe the reduction process. The manufacturing stage concept is regarded by many lithic technologists as an essential analytical concept and by others as highly problematic and of limited utility (cf. Shott 1996, 2003; Shott et al. 2011). On one important point, there is a general consensus: stone tool manufacture, indeed all reduction technologies, are a continuum, and because of this the parent material is reduced in size as the process unfolds. Too little is known of the Rapanui cut stone manufacturing technology to know whether the reduction sequence can or should be characterized as consisting of a series of discrete and readily identifiable stages. In this paper, I have described some stones as “early” or “late” stage *paenga* based on a rough and obviously subjective assessment of the number of squared corners and overall symmetry or regularity in the overall morphology. This has been done for purely descriptive purposes and should not be taken as an endorsement of a two-stage reduction sequence that could be used in future studies of cut stone manufacture.

The Rano Kau Quarries and Isolated “Semi-finished” *Paenga*

Three cut stone quarries and two “semi-finished” or late stage *paenga* that appear to have been abandoned during transport were identified on Rano Kau in the 1968 survey (McCoy 1976:Figure 41). All of these are

located within the boundaries of what geologist P.E. Baker has mapped as mugearite and benmoreite lavas (Baker et al. 1974; Baker 1993, 1998). These lavas, which Baker has classified as intermediate lavas, are restricted to the eastern side of Rano Kau, and areas to the west, north, and east of Maunga Orito (Baker et al. 1974:Figure 1; Baker 1998:Figure 1). Baker described the lavas as follows:

“On Rano Kau the benmoreite is unusual, with disequilibrium textures interpreted as resulting from the mixing of basalt and rhyolite. However, for the most part the intermediate lavas are relatively fine-grained and not particularly vesicular. They solidified from fairly viscous lavas and most significantly developed a slabby or flaggy structure on eruption... the flaggy character, lack of vesicles and uniformly fine-grain size made these intermediate lavas excellent building material.” (Baker 1998:281).

Some adzes (*toki*) were also made of this same stone. These flows are part of what Vezzoli and Acocella have called the caldera stage, with dates of 0.35-0.34 Ma. (Vezzoli & Acocella 2009:Figure 5).

Two of the quarry sites (Sites 2-83 and 2-85) and one of the “finished” *paenga* (Site 2-41) are located on the east rim of the volcano (caldera) near the top of a large rock outcrop (*puku*) at an elevation of ca. 300 plus meters, just to the east of Vai Atare (McCoy 1976:Figure 46). These fall within the area mapped by Gonzalez-Ferran et al. (2004) as Vai Atare Runga benmoreite flows (Figure 4, symbol RK2a).

Vai Atare³ is one of several “storied places” in this area (cf. Barthel 1978:222-223; Englert 1948:130-131, 173, 289, 379; Routledge 1917:352; Van Tilburg 1992:14), that is rich in archaeological sites and on current evidence has a long and complicated history (Ayres 1975:29-43; Lee 1992:156-166; McCoy 1978:213). Van Tilburg (1992:59, 2004) has suggested that the exquisitely carved basalt statue called Hoa Hakananai‘a that was removed from a house at ‘Orongo in 1868 by the crew of HMS *Topaze* may have been carved at Vai Atare. In this same area are a large number of circular house foundations called *hare oka* and other house types that I have previously interpreted as temporary habitation sites, some of them possibly occupied during the bird cult festivities at ‘Orongo (McCoy 1976:Figure 25, 105-107; 1978:213). Georgia Lee, who documented a number of petroglyphs at Vai Atare, suggested that the rock art in this area might be connected with stone quarrying (Lee 1992:158).

Site 2-83

Site 2-83 is a major dressed stone manufacturing “locality.” There are areas of outcrop with pecked surfaces indicating an early stage in the manufacturing

process, as well as a number of worked angular blocks in various stages of completion. In several places, smaller stones were inserted into the interstices between two contiguous blocks. These were provisionally interpreted as “wedges” that may have functioned to maintain a space for the use of a hammerstone. The ground surface around some of the blocks was littered with broken beach cobbles (*poro*) that on current evidence appear to have been the primary manufacturing tool.

Site 2-85

Site 2-85, located in relatively close proximity to Site 2-83, and exhibiting all of the same general characteristics, is another major dressed stone manufacturing locality, with at least three large unfinished stones (Figure 5a-5b). A photograph of one partially finished stone illustrates what would appear to have been a common reduction method in the shaping of the sides. On one edge of this stone can be seen a



Figure 5a and 5b. Site 2-85 early stage *paenga* marked by “X” on Rano Kau (photos by Herb Pownall).

fairly wide and deep crack and partially detached block (Figure 5a), which most likely was done with a beach cobble hammerstone since the edges of the crack are relatively wide and heavily bruised and battered.

There is an abundance of manufacturing detritus at this site, consisting of both small, fine-grained pieces of rock and several flakes, 1-2cm thick and 10-15cm across. Broken beach cobbles were found on this site, as well as some adze fragments that would also appear to have been used as manufacturing tools.

Site 2-112

Site 2-112 is located well downslope of the previous sites, at approximately 160m in elevation, just above the cliffs at Ko te Ihu and a small islet called Motu Rau Uri (McCoy 1976:Figure 47). The quarry is located on a low rock outcrop, around which there is also some evidence for a possible habitation site. There are numerous areas of exposed outcrop suitable for *paenga* manufacture at this locality. There are five and probably more essentially finished or late stage *paenga* in the immediate vicinity of the site, which, like the other sites, has no defined boundaries (Figure 6). The average size of the stones is 90cm by 50cm by 50cm. The dimensions suggest that these essentially cube-shaped stones were probably intended for use in an *ahu* wall, rather than in house foundations. It is also possible that these blocks might have been further reduced, even split into two parts, after transport. None of the diagnostic detritus from pecking and hammering was seen at this site, but this is probably because any such material had been buried by slope wash.

There are only a few other sites in this area, which appears to have been sparsely populated. Two habitation sites (2-113 and 2-114) with lithic scatters comprised of obsidian flakes, fire-cracked rock, and beach stones are located a short distance upslope of the quarry at the base of rock outcrops. Site 2-114 is a very well preserved *hare oka* foundation c. 3.75m in diameter (illustrated in McCoy 1976:Figure 23). A little farther upslope is an isolated pair of habitation sites (2-110 and 2-111). The latter has a circular stone outline over 5m in diameter, which appears to be another *hare oka*. The presence of two circular houses in close proximity to the quarry is noteworthy and of potentially great significance. It is possible that these houses, which are a temporary form of dwelling, were occupied by the stone cutters and that radiocarbon dates and other useful information could be obtained through excavation (see Stevenson et al. 2007 for interesting information obtained in the excavation of a *hare oka* in the Vaitea area).

Isolated “Semi-finished” *Paenga* (2-41 and 2-113)

One of the most finished *paenga* on Rano Kau was found at Site 2-41, which is located on the side of an outcrop at the roughly 305m elevation in the same general area as Sites 2-83 and 2-85. The *paenga*, which is well shaped and partially smoothed, measures 2.45m long, 70cm wide, and 35cm thick (Figure 7). The dimensions suggest that it was probably intended for use in an *ahu* wall. The second “semi-finished” *paenga* on Rano Kau was found next to a rock outcrop a short distance upslope of Site 2-113. No further data are



Figure 6. Site 2-112 late stage *paenga* marked by “X” on Rano Kau (photo by Herb Pownall).



Figure 7. Site 2-41 isolated, “semi-finished” *paenga* in transport on Rano Kau with author (photo by Herb Pownall).

available for this particular *paenga*, which obviously needs to be re-located and documented in detail.

The degree of finish and unstable position of the two *paenga* suggest that they were in the process of being moved from a nearby quarry, but were for some reason abandoned. Why both of these objects are so well-finished is difficult to understand if they were indeed being transported, given the potential for damage to the corners and sides in removing them from rocky outcrops.

The Maunga Tararaina Quarry

The Maunga Tararaina quarry (Site 4-123) is located at c. 100m in elevation on a benmoreite and mugearite flow on the northeast side of Maunga Tararaina, a large scoria/tuff cone (Baker 1998:Figure 1) that rises above a flat plain and is one of the more prominent landmarks in the Hanga Roa area (McCoy 1976:Figure 48). According to Vezzoli and Acocella (2009:Figure 5), Tararaina is a mugearite flow associated with Maunga Terevaka and dates to less than 0.30 Ma. Gonzalez-Ferran et al. (2004) have included Maunga Tararaina in their Tangaroa volcanic group, which also includes other notable geologic features, such as Puna Pau (Figure 4).

There are only a few other sites in the vicinity of this quarry, which thus appears to be relatively isolated. This is probably due in large part to its proximity to the population center at Hanga Roa and

the long-term effects of intensive farming in the area. The most important site in the area is Ahu Moa te Eru Eru (Site 4-114), a name that was applied to the area of the quarry as well (McCoy 1976:Figure 48). Based on spatial proximity, it is reasonable to assume that the quarry would have been the source of dressed stones in this and probably other *ahu* on the west coast in the vicinity of Hanga Roa and Tahai, but this obviously remains to be demonstrated through sourcing studies.

The evidence for quarrying at this locality consists of several partially shaped stones, some angular detritus, and the ubiquitous beach cobble hammerstones. Most of the work appears to have taken place in a trough-like depression that may have resulted in part or whole from earlier quarrying (Figure 8). An unfinished early stage *paenga* was in the process of being separated from the parent rock with the aid of small cobbles used as wedges. Removal of this block would have required undercutting the bottom side.

A number of petroglyphs were found in this quarry, but unfortunately most of them are faint and could not be easily identified and documented. My field notes contain sketches of two of the more clearly visible motifs. One resembles the small *moai* petroglyphs carved on the side of statues at Rano Raraku (Lee 1992:Figure 4.19 top). The other appears to be the outline of a canoe similar to those found on unfinished topknots at the nearby Puna Pau quarry (Lee 1992:Figure 4.102).



Figure 8. Site 4-123 early stage *paenga* on edge of a lava flow near Maunga Tararaina (photo by Rafael Rapu).

The Ko Ori Quarry

This quarry (Site 6-414) is located on the southeast flank of Ko Ori at roughly 65m in elevation, some 1.3km inland of Hanga Tee (McCoy 1976:Figure 50). Based on its location, this quarry would presumably have been a primary source of the dressed stones in the *ahu* and *hare paenga* in the Vaihu and Akahanga settlements on the south coast.

The Ko Ori quarry is situated on a large outcrop that Baker mapped as Terevaka basalt/hawaiiite lavas (Baker 1998:Figure 1). Vezzoli and Acocella (2009:Figure 5) also describe the quarry flow as a hawaiiite and give a date of 0.11 Ma. Ko Ori is included in the Gonzalez-Ferran et al. (2004) Tangaroa volcanic group (Figure 4). Several partially finished quadrangular-shaped cut blocks were found at the base of the outcrop. One measures 2.4m long, 1.9m wide, and 80cm thick. A petroglyph was found on this same block. It is a circle 40cm in diameter that was made by pecking. A second, nearly finished block measured 1.8m long, 64cm wide, and 26cm thick. There are several other unfinished blocks that have been pecked and shaped to the point where they are identifiable as early stage *paenga*.

The quarry is part of a well-defined cluster of four sites (6-412 to 6-415) in an area called Retu (McCoy 1976:Figure 50). Site 6-412 is an unusual cremation burial (*avanga*), with one and possibly two repositories for cremated bones contained within a 4.20m by 3.40m

pavement outlined by vertical slabs. The interior surface is paved with flat stones and beach pebbles. Adjacent to this feature is an oval-shaped feature that may be another *avanga*. Site 6-413 is house site with a beach stone pavement and one buried *paenga*, which may have been part of a house foundation. Site 6-415 is a small rock overhang (*karava*) and chicken house (*hare moa*), of which all that remained was the foundation.

The Dressed Stone Manufacturing Technology: A Preliminary Model

The observations made during the 1968 survey on the five quarry sites and isolated *paenga* are too limited to permit more than a few tentative remarks on the manufacturing technology. The emphasis here is on describing what appear at this time to be the salient characteristics of the manufacturing process, including raw material acquisition, reduction strategies and sequences, manufacturing methods and tools, and the morphological variety of cut stones manufactured at the five quarries.

Morphological Variability and Quantity of Dressed Stones in the Five Quarries

Two different kinds of blocks were observed in the five quarries described in this paper: (1) cube-like blocks (Figures 5 & 6), and (2) long, narrow rectangular blocks (Figure 7). The former would appear to have been made for use in *ahu* wall facades and the latter

for either *ahu* or *hare paenga* foundations. None of the more finished stones, even those found in transport such as at Site 2-41, were of necessarily final form, however. It is highly probable, for example, that some of the larger, thicker stones were subsequently split into two, as suggested by the occasional dressed stones with long, narrow grooves found at some *ahu* (Mulloy & Figueroa 1978:Plate 9; cf. Figure 3, this paper, showing a groove on one of the slabs in the seaward wall of Ahu Vinapu 1). No such grooves were observed at any of the five quarries.

Raw Material Acquisition and Reduction Strategies and Sequences

As already noted, no obvious signs of subsurface mining or quarrying, such as pits, were observed at any of the five quarries. It appears that the raw material procurement process consisted, instead, of the stone-cutters choosing either:

- (1) blocks of stone that were partially or completely separated from the parent rock (e.g., Sites 2-85 and 2-112), or
- (2) a side or edge of a rock outcrop where the cutting and shaping process took place *in situ* (e.g., Site 4-123).

The first method of procurement, which appears to be common at many sites called “quarries”, might be described as akin to “surface collecting” or “foraging” and the latter method as a process approximating actual quarrying or mining, even though the work appears to have been limited to surface exposures at these particular sites.

The two alternative methods of obtaining raw material correspond to two similar, yet slightly different, reduction sequences. The first sequence, involving the reduction of free blocks of stone, is inferred to have been a shorter and, thus, preferred strategy, although such blocks may have been generally smaller and perhaps of lesser value. The second method, which would have been more time-consuming and labor-intensive, is the same reduction process and strategy that was used at the Rano Raraku statue quarry where statues were carved *in situ* and eventually freed from the bedrock by undercutting of the bottom or back side (Skjølsvold 1961b:367). This is the same method that was used in the Marquesan quarries described by Linton (1925:8-9).

On present evidence, work in all five quarries documented in 1968 was limited to the basic shaping of stones of desired shapes and sizes. The final finishing process of abrading and smoothing the surfaces clearly took place outside of the quarries, as none of the more finished stones, even those ready for transport or in transport (e.g., the stone at Site 2-41), exhibit the same finish and beveled surfaces as those found in the cut stones that form the seaward wall of Ahu Vinapu 1

(Figure 3), or the smoothed surfaces seen in many *hare paenga* foundation stones. Also, no implements that could be interpreted as abraders and smoothers were observed at any of the quarries.

Manufacturing Methods and Tools

It appears at this time that the two reduction sequences used the same manufacturing techniques and tools. The most common manufacturing method or technique appears to have been pecking using a rounded beach stone as a hammer. Broken hammerstones of this type were found at all of the quarries. While I did not record the size of the hammerstones at any of the sites, I recall that most were “hand-sized” cobbles. No picks (*toki*) of the kind found at the statue quarry at Rano Raraku (Skjølsvold 1961b) were observed at any of the quarries. Roughed-out basalt adzes were used, but perhaps not as often. The same toolkit would appear to have been used in the Marquesas. According to the information collected by Linton (1925:9), narrow bitted adzes were used in stone quarrying rather than picks. The only site where such implements were found was Site 2-85 on Rano Kau. The presence of several flakes and angular rock fragments (“shatter”) at Site 2-85 on Rano Kau and at the Ko Ori quarry suggests the possibility that direct free-hand percussion was used on the corners of some blocks, but such debitage, which did not appear to be common, could just as well have been detached in the pecking process. The cobbles found in the cracks between two contiguous blocks at the Rano Kau and Maunga Tararaina quarries appear to have been used as “wedges”, perhaps not for splitting, but simply to keep the two rock surfaces apart to make room for a hammerstone.

Although there is no evidence for it, it is possible that water was used in the pecking process. In the replicative experiments conducted at Rano Raraku, in 1955-56, Skjølsvold found that water was an important aid in the carving of stone statues:

“The stone was dampened with water from hollow gourds the whole time in order to make the work easier. When asked about this, the natives explained that it was an ancient tradition on the island.” (Skjølsvold 1961b:368).

One tool that is known from ethnographic descriptions to have been used in the final dressing of cut stones, but which was not observed at any of the quarries, is the smoothing or rubbing stones called *herehere* that are natural pieces of obsidian with a coarse cortex (Englert 1948:218; Fuentes 1960:737). This is one more piece of evidence pointing to the high probability that the final stage of manufacture took place outside of the quarries.

Chronology, Scale, and Temporality of Production

There are no absolute dates available for the appearance of dressed stone masonry on Rapa Nui. It is highly doubtful that the earliest *ahu* had such masonry. Dressed stone masonry probably appeared first in *ahu* and only much later in the foundations of *hare paenga* and other structures (Mulloy & Figueroa 1978:126). According to oral traditions, the *hare paenga* was introduced by a craftsman named Nuku Kehu who came to the island with Hotu Matu'a (Englert 1970:49). Ferdon (1979) suggested a possible Tuamotuan origin of the boat-shaped *hare paenga* and circular houses (*hare oka*) found on Rapa Nui. Stevenson (1997) has proposed a 14th century date for the appearance of the *hare paenga*.

A terminal date for the end of *paenga* manufacture is also not available at the present time. In the case of use in *ahu* walls, it is possible that it coincided with the cessation of image *ahu* construction, which Smith dated to the late 17th century (McCoy 1976:90; Smith 1961b:218). *Hare paenga* were occupied well into the post-contact period as evidenced in the foreign items recovered in the excavations that have been undertaken

at various localities, such as Anakena, Rano Raraku, and Vinapu (Mulloy 1961:135; Skjølsvold 1961a:293; Smith 1961b:282-283), and the first-hand accounts of various individuals (e.g., Routledge 1919:216).

There are insufficient data to determine the scale and chronology of *paenga* manufacture in the study area, except to say that the five quarries taken as a whole do not appear large enough to have supplied all of the dressed stonework found in the *ahu* and *hare paenga* found in the 1968 survey area (cf. Figure 9). Production output in quarries is difficult to calculate, however, and this tentative conclusion could be wildly wrong. Nevertheless, I would predict that sourcing analyses would demonstrate that some and, perhaps, a considerable amount of the dressed stones in the *ahu* and *hare paenga* in this part of the island was obtained through exchange with *mata* (clans) or lineages from other parts of the island.⁴

The *paenga* quarries recorded in 1968, like the Rano Raraku statue quarry (Skjølsvold 1961b), give the impression of having been suddenly abandoned. All of them have stones in various stages of completion and manufacturing tools lying around on the surface.

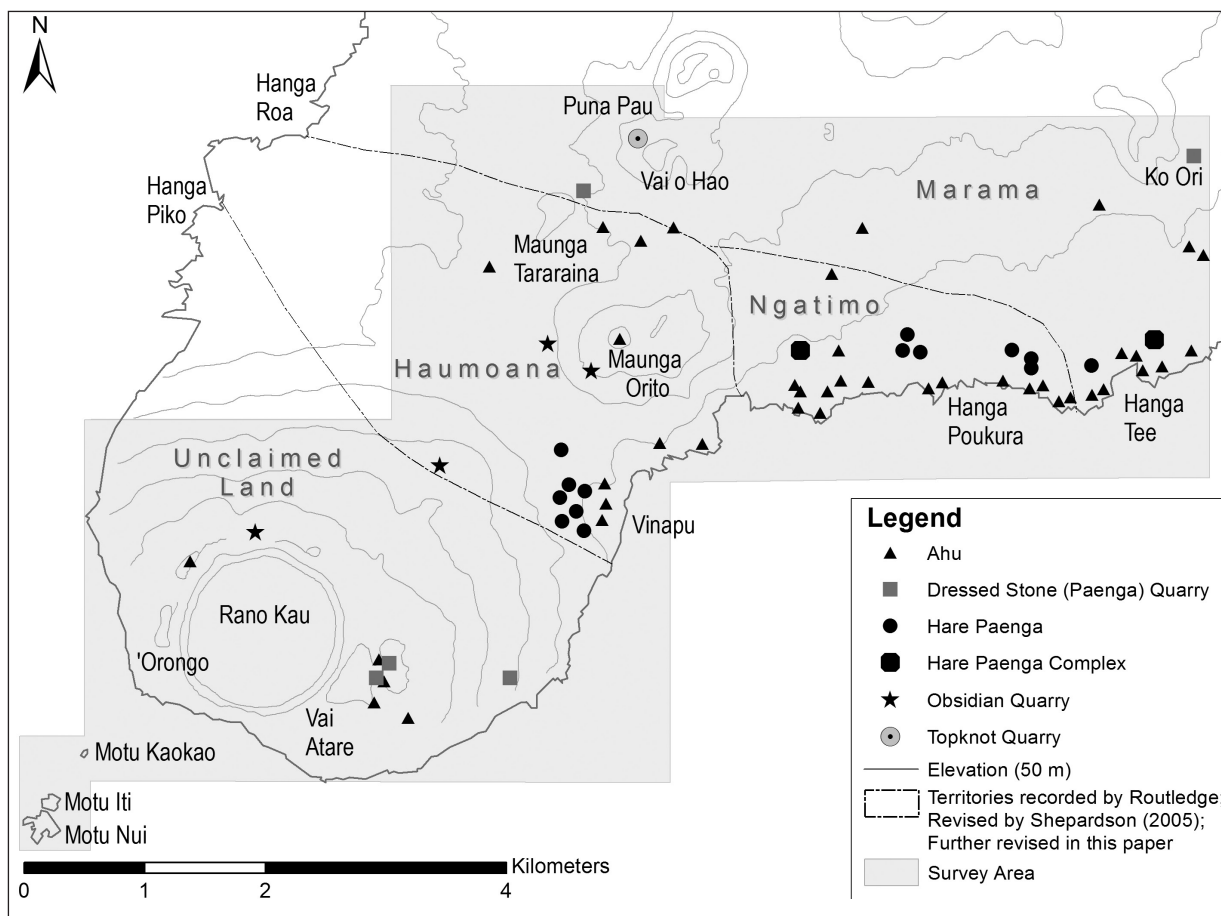


Figure 9. Dressed stone quarries, *ahu* and *hare paenga* locations in the 1968 survey area, in relation to ethnographic period clan territories (after Routledge 1919: Fig. 91, McCoy 1976: Figs. 21, 41, and Shepardson 2013: Fig. 8.18).

The evidence for unfinished projects notwithstanding, the impression of an abrupt end to the work may be illusory. It may be, for example, that quarries were not worked continuously, but rather intermittently as has been also suggested for the obsidian quarries at Maunga Orito (McCoy 1976:90). It may be, too, that stone cutting was not a full time profession, even at the height or peak period of production, or as suggested above, some stone-cutters split their time between work at the Rano Raraku statue quarry and *paenga* quarries.

The Mode of Production, Skill, Knowledge, Ritual, and Relationship to Statue Manufacture

While technology is commonly defined as the “bodies of skills, knowledge, and procedures for making, using, and doing useful things” (Merrill 1968:576), skill itself can be conceptualized as “at once a form of knowledge and a form of practice” (Ingold 2000:316). The level of skill and knowledge involved in dressed stone manufacture is hard to gauge on archaeological evidence alone. Métraux thought the basalt at Rano Aroi “was easily worked by primitive methods owing to its vesicular and coarse texture” (Métraux 1940:194). Even if it was easily worked, as Métraux claimed (and this is doubtful based on the density and hardness of basalt), this does not mean that it was practiced by just anyone, just as the carving of statues from the relatively easily worked volcanic tuff of Rano Raraku was not a craft engaged in by just anyone.

The quantity and quality of cut stonework on the island, and the religious and socio-political contexts in which it is found, point to the high probability of specialized labor in its manufacture. There is reasonably good ethnographic evidence supporting this inference. As noted earlier, we have good reason to believe that *hare paenga* were built by specialists and that this work involved a division of labor.

There is no information as to whether the specialists who quarried *paenga* and the statue carvers were the same men, but since the two technologies employed the same basic skills, knowledge, and techniques it seems highly probable that at least some of them would have spent some time in each kind of work. Even if they were not the same individuals, there is good reason to think that those engaged in quarrying and finishing *paenga* were, like the statue carvers, “a privileged class, highly esteemed” and that the “profession was transmitted from father to son” (Métraux 1940:137). It is reasonable to assume, moreover, that because *paenga* manufacture was done by and for the chiefs that they would have been compensated in the same general way as the statue carvers with what could be called “luxury” foods:

“Tepano told me that expert stone carvers (*tangata maori anga moai maea*) received orders from people

who wanted a monument for their ahu. They worked under the leadership of a master (*tangata honui maori*) and were paid in fish, lobster, and eels.” (Métraux 1940:137).

Ethnographic Period Socio-Political Context of the Five Quarries and the Implications for Control and Access

According to a well-known oral tradition, Rapa Nui was settled by a small group of people from the west led by a man named Hotu Matu’a who became the first king and who, just prior to his death, gave each of six sons a piece of land that became the territories of separate social groups (*mata*). By the ethnographic present, there were ten or so *mata* that no longer occupied discrete territories, however, but were instead mingled together in two large clan groupings, one on the western side of the island, called Tuu, Ko Tuu, or Outu, and another on the eastern side, called Hotu Iti (Métraux 1940:120-122; Routledge 1919:221).

While there seems to be a general acceptance of the names and geographic locations of the primary clans at the time of European contact, the actual boundaries separating the clans and lineages is much less certain. There is no way of knowing, moreover, whether the boundaries recorded by Routledge and Métraux existed at the time the dressed stone quarries were in use. Based on what we know from other parts of East Polynesia, there is a high probability that territorial boundaries were never fixed for any great length of time because of factors such as internal conflicts and changes in leadership. Using the information on traditional land divisions obtained by Routledge (1919:Figure 91) and Métraux (1940) with the caveats just mentioned, the five quarries fall within the lands of three closely related clans of the Ko Tuu confederation—the Marama, Ngatimo, and Haumoana (Figure 9). According to Métraux’s information, the Marama, named after the third son of Hotu Matu’a,

“...occupied a long strip of land from the west coast to the south coast. They are frequently mentioned with the names of certain important places where they were numerous. They are spoken of as the Marama of Tahai, the Marama of Vaihu, the Marama of Hanga-roa. The district given by Hotu-matua to his son Marama does not coincide exactly with the distribution of the Marama tribe. It includes the territory of the Ngaure, the Ngatimo, and a part of the Haumoana, but it does not extend to the west coast through the interior of the land. The Haumoana, like the Marama, extended from the southern coast to the western coast. Haumoana people are mentioned east of their boundary, settled in the district of the Ngatimo. The Ngatimo group was concentrated in a very short section of the south coast where fishing was

unfavorable. However, Ngatimo families occupied the shore from Vinapu to Vaihu" (Métraux 1940:125).

Métraux (1940:122) was of the opinion that the Ngatimo and Haumoana "tribes", whose origins cannot be attributed with certainty to an ancestor with a fixed genealogical position, were sub-tribes of the Marama. The Maunga Tararaina quarry appears to be located near or on the Marama and Haumoana territory boundary, which may have been on the north side of Maunga Tararaina in the area called Moa te Eru Eru. Van Tilburg (1994:Figure 69) shows the *ahu* of this name on the boundary. It is possible, then, that at one time the Marama controlled and may have had exclusive use rights to all five of the cut-stone quarries discussed in this paper, as well as the Rano Kau and Maunga Orito obsidian quarries and the Puna Pau topknot quarry (Figure 9).

The most problematic of all the quarries in terms of "ownership" or use-rights are those on Rano Kau. In the traditions recorded by Routledge (1919) and others, there is no reference to the allocation of lands above Vinapu. Routledge and Métraux both claim that the southwestern tip of the island (i.e. Rano Kau) was not a part of either the western (Ko Tuu) or eastern (Hotu Iti) districts, but was settled by families from several tribes or clans that belonged to the western confederation.

"In Kotuu, the Marama and Haumoana inhabited side by side the land running from sea to sea between the high central ground and the western volcano Rano Kao. They had a small neighbour, the Ngatimo, to the south, and jointly with the Miru spread over Rano Kao and formed settlements by the margin of the crater lake." (Routledge 1919:221).

"The southwestern point of the island with its volcano, Rano-Kao, was also outside of the districts, though some Marama, Haumoana, and Miru families lived near the present Mataveri and by the Ahu-rikiriki on the southern slope of the volcano." (Métraux 1940:125).

If we accept the ethnographic accounts, which are admittedly incomplete and open to question as noted above, there are two possible scenarios that might have played out in the still unknown history of cut stone quarrying on Rano Kau:

- 1) the Rano Kau summit area was a "commons" that was open to use by members of a number of different clans of the Ko Tuu confederation, or
- 2) one clan, presumably the Marama, had proprietary rights to the summit region but granted access to other groups in exchange for some unknown products or services.

Summary and Discussion

The data presented in this paper on five dressed stone quarries and several isolated, semi-finished dressed stones, although incomplete, have provided some preliminary insights into various aspects of the manufacturing technology and its inferentially close relationship to statue carving. The data from these quarries, combined with archaeological and ethnographic information on the varied utilitarian, symbolic, and ritual uses of dressed stones, suggest that *paenga* manufacture had developed at some point in its history into a craft specialist "industry" involving production for exchange in what is oftentimes referred to as the "public" or "political" economy (Earle 1987, 1997; Peebles & Kus 1977:423; Sahlins 1972:101; Simpson 2009).

References in the ethnographic literature to groups of men working under master craftsmen in the quarrying of foundation stones indicates that *paenga* manufacture, like other craft specializations such as statue carving (Van Tilburg 1994), were what Handy (1927) called "consecrated enterprises," a term he used to highlight the pervasiveness of ritual in Polynesian crafts:

"The main features of all kinds of consecrated enterprise were everywhere fundamentally the same. These were: organization and direction under master craftsmen or adepts, and priests; worship of patron deities, who were commonly deified men, by means of prayer and the presentation of offerings; tapu and purificatory rites designed to insulate the work, the workers, and the product, from evil; the taking of omens relative to the outcome of the enterprise; empowering workers, places, instruments, and the products by using conductors of mana, and endowing them directly with mana through spells; consecrating the finished product by means of ritual; and finally, feasting and general merrymaking to mark the end of the consecrated period, to enjoy the product, and to render thanks to the gods." (Handy 1927:282).

Polynesian craft specialization, an activity that "replicates the work of the gods for Polynesians, and is thus *tapu* activity" (Shore 1989:149-150), is an example of what Helms (1993) has more recently termed skilled crafting. In contrast to everyday or mundane ways of making things, skilled crafting, as defined by Helms, involves objects that "are usually reserved for, controlled by, or associated with persons of influence and that require particular personal crafting skills or are associated with status identification as artisans" (Helms 1993:13). The dressed stonework used in the construction of many

ahu and in the foundations of *hare paenga* occupied by political and religious leaders clearly points to a kind of craft work that was “non-utilitarian and non-pragmatic, being ideological in meaning and moral or honorable in quality rather than being strictly materially or economically useful (Gluckman 1965:279-280)” (Helms 1993:14). There is good reason to believe that the people involved in the manufacture, transport, final dressing, and placement of cut stones were motivated individuals who were seeking honor, status, and prestige (Goldschmidt 1990:32).

If *paenga* manufacture was undertaken by specialists in the kind of ritualized settings described by Handy (1927:282), then what evidence exists for the worship of patron deities and other kinds of ritual behavior associated with occupational specialization all over Polynesia? The evidence is circumstantial. First of all, there are no shrines at any of the five quarries identified in 1968 and, thus, no material evidence of offerings to tutelary gods of cut stone manufacture.⁵ The petroglyphs found at or near the quarries may have been part of some ritual, but the meaning and age of the petroglyphs are unknown. The relative isolation of the quarries, which are not far from areas of permanent habitation, and evidence for what may be temporary work camps on Rano Kau, suggests that the physical separation may have been deliberate and related to a temporary *tapu* on the quarries and the stone-cutters.

Final Remarks

The yet still short history of Rapa Nui archaeology, like archaeology everywhere, evinces certain biases, preoccupations, and taken for granted assumptions and “facts”, which change over time with the development of new research questions and theoretical perspectives. I think most archaeologists would agree that the Norwegian Archaeological Expedition (NAE) of 1955-56 marked the beginning of modern archaeology on the island and that it also effectively set the agenda for local archaeology for a number of years (cf. Van Tilburg 1996). The focus of the NAE on the excavation and dating of ceremonial structures (*ahu*) and investigations of the Rano Raraku statue quarry continue today (e.g., Ayres 1973; Hamilton et al. 2008; Martinsson-Wallin 1994; Martinsson-Wallin et al. 2013; Mulloy & Figueroa 1978; Stevenson 1986; Van Tilburg et al. 2008). However, almost 60 years after Arne Skjølsvold’s research at the Rano Raraku quarry, relatively little is known about other quarry production systems, except for the limited research undertaken so far on the Maunga Orito obsidian quarry complex (McCoy 1976; Stevenson et al. 1984, 1988, 2013), one adze quarry (Ayres et al. 1998; Stevenson et al. 2000), pXRF sampling of basalt (Van Tilburg

pers. comm. 2014; Simpson n.d.) and the recent work at the Puna Pau topknot quarry (Hamilton 2007, 2013). How many *paenga* quarries have been found in surveys undertaken after 1968 is unknown, as much of the survey data collected during the last 45 years is unpublished and unavailable.

The lack of research on *paenga* quarries is especially puzzling given the long history of debate about the cultural origins and chronological relationship of dressed stone masonry to other masonry techniques, and the varied uses of dressed stones that are found virtually everywhere on the island. The manufacturing technology, indeed the whole production process, has clearly been seen as irrelevant to the debate concerning possible Andean influences, but the reason is difficult to understand since the debate is focused on the form and quality of the masonry. The preoccupation with other research problems has also left unanswered the question: why there is so much dressed stonework on Rapa Nui compared to other islands in Polynesia, except for the Marquesas (Linton 1925), how the technology developed and changed over time, and what role it played in the development of social complexity.⁶

Looking ahead to the future, quarries should theoretically assume a privileged position in the study of dressed stone production and distribution because of: (1) the direct link to the “consumers,” the heads of clans and lineages, (2) the difficulties of determining the original source or sources of dressed stones from habitation sites and other contexts because of the kinds of recycling behaviors discussed above, and (3) the varied means by which dressed stones could have been acquired. So while sourcing analyses have been successful in discriminating between the lavas of the three primary volcanic centers (Rano Kau, Terevaka, and Poike), it seems to me that there will always be an equifinality problem in determining whether the *paenga* in a particular *ahu* wall or house foundation were obtained through direct access or some form of trade or exchange. One problem is that resource “ownership”, access, and control, on which interpretations of dressed stone acquisition will be ultimately based, are especially difficult to identify and document archaeologically, even when ethnographic data are available. The possible existence of a “commons,” such as the Rano Kau area, is a further complicating factor in trying to distinguish archaeologically between direct access and exchange in the late prehistoric period, when corporate descent groups appear to have no longer occupied well-defined territories. In the end, the real problem is that the archaeological signatures for direct access and production for trade or exchange are most likely indistinguishable. Finally, there is the pervasive problem that exchange tends to be assumed rather than demonstrated empirically; to talk about trade

and exchange requires knowing what was exchanged for what (Meighan 1992:2; Skinner et al. 2004:227-228). There may be ways around these obstacles and one can only look forward to new and exciting data on dressed stone production and exchange. My own hope would be for research that has less of an economic focus and that would be oriented instead at obtaining an understanding of the technology in the broadest sense of the word along the lines suggested in Handy's (1927) early research on Polynesian craft specialization, Helms' (1993) recent work on skilled crafting, and Ingold's essays on skill (2000) and the making of things (2013).

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Heartfelt thanks goes to Brigid Mulloy, who has helped to get me moving again with some unfinished papers and other projects related to Rapa Nui archaeology. Special thanks goes to Mara Mulrooney, who expressed an interest in publishing this paper in RNJ and volunteered to help with the illustrations. Mara labeled the photographs and drafted all of the maps. The paper would not have been completed without her direct involvement in the production process. The paper was peer-reviewed by Chris Stevenson and Mark McCoy, both of whom provided a number of helpful and much appreciated comments.

Notes

1. As originally conceived by William Mulloy (1968), the archaeological survey of Rapa Nui, begun in 1968, was not problem-oriented and did not involve excavation. The aim of the survey, which Mulloy thought could be accomplished in a relatively few short years, was to make a catalog of sites (McCoy 1976:11). One result of not having conducted excavations and obtained radiocarbon dates, was the consequent inability to talk about the age of different site types and diachronic changes in settlement patterns, as critics have pointed out. In 1973, when I completed my doctoral dissertation, there were no reliable obsidian hydration dates and the only radiocarbon dates available were the 18 obtained by the Norwegian Archaeological Expedition (NAE) of 1955-56, most of them from *ahu*, the Rano Raraku statue quarry, and ceremonial center at Orongo (Smith 1961a:393-396). Contrary to what some have read into my earlier work (e.g., Mulrooney et al. 2009:96-97), I do not subscribe to and have never adhered to the NAE three-period cultural sequence. I have, of course, mentioned it (e.g., McCoy 1979:156, 159), and I also used it in a preliminary chronological ordering of *ahu* in the 1968 survey area (McCoy 1976:95-102). I purposely avoided using the NAE sequence in my settlement pattern studies, and instead used a more general, not wholly satisfactory chronological framework of my own derivation consisting of two broad cultural stages that I called the Late Prehistoric Period and Protohistoric Period, spanning the period between c. AD 1550 and 1865 (McCoy 1976:ii). Based on the limited amount of information available four decades ago, I surmised that most of the surface remains in my study area probably dated to that time frame. Thankfully, the lack of dates for domestic architecture and settlement features is being rectified through the recent work of Stevenson and colleagues in the interior of the island (Stevenson 1997) and in the Hanga Ho'onu area (Stevenson & Haoa 2008; Mulrooney (2012, 2013).
2. Rough cut, unfinished quarried stones, with or without depressions for rafters, called *pae* appear to be widespread on the island. In addition to Rano Kau, they have been found at other more inland locations, such as Maunga Tari, where there is also evidence of temporary camp sites like those on Rano Kau (Simpson 2009; Stevenson 1997:94-96). The smaller size and inferior quality of the *pae* suggests that they may have either been: (a) by-products of *paenga* manufacture (e.g., blocks too small to be used in the foundation of a chief's or priest's house) that were appropriated by commoners and/or non-specialists, or (b) made by commoners for their own purposes using smaller chunks of basalt and other rock types from the immediate surroundings of their houses and gardens. Each of these two alternative forms of acquisition would have been essentially opportunistic (see Protzen 1993 on Inca opportunistic quarrying), as opposed to *paenga* manufacture, which is assumed to have targeted the best available sources in terms of the lithology and form of the lavas found within a clan or lineage territory.
3. Vai Atare (literally, "the water of Tare," a god) refers to both a place and natural water holes. According to my fieldworkers, there are two places of this name, Vai Atare Raro (below) and Vai Atare Runga (above). There are a number of exceptional sites and artifacts in this area, including some directly associated in local traditions with Hotu Matu'a. There are also some

- exceptionally well-carved and decorated stone bowls or basins (*taheta*) in this area (McCoy 1968 unpublished field notes; Lee 1992:Figure 5.39).
4. Information on the pre-contact period social structure and organization of Rapa Nui is incomplete and confusing. The primary social unit appears to have been the *mata*, which Routledge (1919:221) regarded as a clan and Métraux (1940:120; also see Goldman 1970:119-120) considered equivalent to a tribe, made up of lineages. McCall (1976:36-37) regards the *mata* as a conical clan and describes them as corporate descent groups who owned land with well-defined boundaries demarcated by cairns called *pipi horeko*. For a more recent summary of Rapa Nui descent groups and territorial divisions see Stevenson's analysis of *ahu* distribution patterns (1986:69-70, 2002) and Shepardson's analysis of *moai* locations (2005, 2013). Figure 9 of this paper is based on information collected by Routledge (1919) and Métraux (1940), and Shepardson's (2005, 2013) proposed revisions to Routledge's territorial boundaries. Some adjustments have been made to Shepardson's boundary lines at Vinapu and Hanga Roa based on my opinion that all of the Vinapu ceremonial complex was located within the territory of the Haumoana, and my agreement with Métraux (1940) that there was a Marama settlement at Hanga Roa. I have also adjusted the Haumoana-Ngatimo boundary shown on Shepardson's map (2013:Figures 8.18 to 8.20) by moving it farther west, so that it now corresponds more closely to the boundary line shown on Routledge's map (1919:Figure 91). The adjusted boundary now encompasses all of the large settlement at Hanga Hahave (McCoy 1976:Figure 49). The territorial boundaries of the Ngatimo, who occupied a narrow strip of land on the south coast, have also been adjusted to conform to Routledge's map, to Métraux's description of this small clan, and to my own interpretation of the settlement pattern evidence (McCoy 1976:139, Figure 61). As Routledge originally cautioned, and as Shepardson and I have also acknowledged, the boundary lines on all of our maps are approximate rather than absolute or fixed boundaries.
 5. Unlike other places in East Polynesia, such as Hawai'i, where there are shrines with offerings to tutelary gods of occupations such as adze making and fishing, there do not appear to be any such structures on Rapa Nui. The absence of smaller occupational shrines is one more topic in need of research.
 6. Sahlins (1955) made an interesting, but not wholly convincing argument for the preoccupation with stone statuary carving on Rapa Nui in his paper, 'Esoteric Efflorescence in Easter Island' based on environmental constraints on subsistence agriculture. Graves and Ladefoged (1995), who curiously regard ceremonial architecture as a "superfluous trait," present a hypothesis similar in some respects to that of Sahlins, based on evolutionary theory. They argue that ceremonial architecture had selective advantages in stabilizing the size of the population. Their theory, which has not been tested, is at direct odds with the prevailing idea that the development of ceremonial architecture in Polynesia is related to the exercise of chiefly power in the construction of monuments dedicated to deified ancestors and gods (e.g. Earle 1987, 1997; Kirch 1984, 2010; Kolb 1994). This theory, too, is not without its problems because of the reductionist view entailed in viewing the political economy as the prime mover in the evolution of so-called complex societies (Olsen et al. 2012:184).
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